

POA MATRI-OCCIDENTALIS (POACEAE: POOIDEAE: POEAE: POINAE), A NEW SPECIES FROM MEXICO

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ABSTRACT

Poa matri-occidentalis P.M. Peterson & Soreng, sp. nov., is described and illustrated. **Poa matri-occidentalis** subsp. **matri-occidentalis** is known from steep rocky slopes of Cerro Gordo, Durango, and **Poa matri-occidentalis** subsp. **mohinorensis** Soreng & P.M. Peterson, subsp. nov. is known from rocky cliffs of Cerro Mohinora, Chihuahua. The new species is morphologically similar to *Poa kelloggii* but differs by having leaf sheaths that are closed near the base 2/3 to 4/5 their length, entire ligules that are 3.5–6 mm long, nodding panicles, ovate lemmas with obtuse to acute apices, and non-visible rachilla internodes. A key distinguishing 11 species now reported from northern México is provided.

RESUMEN

Se describe e ilustra **Poa matri-occidentalis** P.M. Peterson & Soreng, sp. nov. **Poa matri-occidentalis** subsp. **matri-occidentalis** se encuentra en la zona de cuevas rocosas escarpadas de Cerro Gordo, Durango, y **Poa matri-occidentalis** subsp. **mohinorensis** Soreng & P.M. Peterson, subsp. nov. se encuentra en la zona de laderas rocosas del Cerro Mohinora, Chihuahua. La nueva especie es morfológicamente similar a *Poa kelloggii* pero difiere de ésta última por tener las vainas de las hojas cerradas en la parte inferior de la base de 2/3 a 4/5 de su longitud, por tener lígulas enteras de 3.5–6 mm de largo, panículas recurvadas, lemas ovadas con ápices agudos a obtusos y raquilla con entrenudos no-visibles. Se proporciona una clave para distinguir las 11 especies reportadas actualmente del norte de México.

Poa L. is the largest genus of grasses, including some 500–575 species that occur in a wide range of habitats from throughout the World (Soreng 1990; Gillespie & Soreng 2005). The genus is characterized by having rather small, multi-flowered spikelets, lemmas that are keeled, unawned, usually 5-nerved, commonly with web-like hairs emerging from the dorsal side of the callus, caryopses that are firm with lipid and a short hilum, lodicules that are broadly lanceolate with a lateral lobe, leaf sheaths closed above the base more than 1/20 the entire length, leaf blades that generally have two rows of bulliform cells (one on either side of the midnerve, these appearing as railroad tracks) and no additional rows of bulliform cells, and blades commonly with naviculate (boat-shaped) apices (Soreng, in press). *Poa* has been divided into subgenera and sections and subsections for North America (Soreng 1998; Soreng in press), the New World (Soreng et al. 2003a), and the World (Gillespie et al. 2006; Zhu et al. 2006).

Northern México (excluding Baja California and Baja California Sur) is not thought to be especially rich in *Poa* species. The following 11 species have been reported from the states of Aguascalientes (Ags), Chihuahua (Chih), Coahuila (Coah), Durango (Dur), Jalisco (Jal), Nuevo León (NL), San Luis Potosí (SLP), Sonora (Son), Tamaulipas (Tamp), and Zacatecas (Zac): *Poa annua* L. (Ags, Chih, Coah, Dur, Jal, NL, SLP, Tamp, Zac), *P. bigelovii* Vasey & Scribn. (Chih, Coah, NL, Son), *P. compressa* L. (Coah), *P. conglomerata* Rupr. (= *P. scaberula* Hook. f.) [Coah is an error since a specimen (J.A. García 49) cited in Beetle et al.

(1999) is = *P. pratensis* L.], *P. fendleriana* (Steud.) Vasey [includes *P. fendleriana* subsp. *albescens* (Hitchc.) Soreng] (Chih, Coah, Son, Zac), *P. infirma* Kunth (listed as synonym of *P. annua* and probably with similar distribution), *P. mulleri* Swallen (NL), *P. orizabensis* Hitchc. (NL possibly an error for C.H. & M.T. Mueller 1248 from Cerro Potosí as determined by A.A. Beetle = *P. mulleri*!, SLP-not yet verified by us from there), *P. pratensis* (Chih, Coah, NL), *P. ruprechtii* Peyr. [includes *P. sharpii* Swallen as a synonym] (Coah, NL), and *P. strictiramea* Hitchc. (Chih, Coah, Dur, NL, Zac) [Beetle et al. 1999; Espejo Serna et al. 2000; Hitchcock 1913]. Of the 10 species known from the region, *P. annua*, *P. compressa*, *P. infirma*, and *P. pratensis* are introduced, and *P. bigelovii*, *P. fendleriana*, *P. mulleri*, *P. orizabensis*, *P. ruprechtii*, and *P. strictiramea* are native. The annuals, *P. annua* and *P. infirma* have been placed in *Poa* sect. *Micrantherae* Stapf, and *P. bigelovii* was placed in *Poa* sect. *Homalopoa* Dumort. (Soreng et al. 2003a). Of the remaining natives, *P. mulleri*, *P. orizabensis*, *P. ruprechtii*, and *P. strictiramea* have been placed in *Poa* sect. *Homalopoa* s.l., and *P. fendleriana* was placed in *Poa* sect. *Madropoa* Soreng (Soreng et al. 2003a).

While making determinations of material in the field using Las Gramíneas de Durango (Herrera Arrieta 2001) and then checking the herbarium at Centro Interdisciplinario de Investigación para el Desarrollo Integral Regional (CIIDIR) in Durango, the first author recognized the unique features of a recent collection from Cerro Gordo. Upon further inspection of collections on loan from various herbaria for a complete revision of *Poa* in México, the second author discovered another, generally pubescent form, occurred near Cerro Mohinora, Chihuahua. The third author then contributed the anatomical portion. We describe these two new forms as a new species of *Poa* with two subspecies. The new species with two subspecies is clearly aligned within subfamily Pooideae, tribe Poeae, and subtribe Poinae (Soreng et al. 2003a, 2003b, 2005).

Poa matri-occidentalis P.M. Peterson & Soreng, sp. nov. (**Figs. 1a–c; 2c–l**). TYPE: MÉXICO. DURANGO: Sierra Madre Occidental, SW slope of Cerro Gordo just below twin rock outcrops (23°12'32.5"N–104°56'54.1"W), 3130–3200 m, 26 Sep 2005, P.M. Peterson 19145 & F. Sánchez Alvarado (HOLOTYPE: US!; ISOTYPES CIIDIR!; MEXU!).

A *Poa kelloggii* Vasey vaginibus connatus 2/3–4/5 longe lateque, ligulis 3.5–6 mm longis integris, paniculus nutans, lematibus ovatis apicibus obtusus ad acutus, rachilibus no visibilibus, recedit.

Loosely caespitose and rhizomatous perennials with intra and extravaginal basal branching. Culms 45–80 cm tall, solitary to several, erect or bases slightly decumbent, terete or weakly compressed; nodes 2–4, terete, glabrous and smooth, 1–3 exserted. Leaf sheaths mostly 3–14 cm long, closed about 2/3 to 4/5 their length, compressed, glabrous and smooth, or sometimes the lower ones retrorsely scabrous to puberulent and with ciliate collars, most sheaths 0.4–1.1 times as long as their blades; collars smooth or with a few hooks, glabrous or ciliate; ligules 3.5–6 mm long, membranous to hyaline, glabrous and smooth, or sometimes puberulent, apex obtuse to acute, entire; blades 2–6 mm wide, flat, abaxial nerves and margins lightly scabrous, adaxially smooth, glabrous throughout, apices narrowly prow-shaped; flag blades 12–22 cm long. Panicles 12–26 cm long, nodding, pyramidal, open, sparse with 24–85 spikelets, longest internodes 2.5–5.5 cm long; branches (1–)2(–3) at the lower nodes, longest 5.5–10 cm long bearing 3–15 spikelets, ascending to spreading, lax, angled, the angles sparingly scaberulous. Spikelets 4–8 mm long, 1.8–2.7 mm wide, laterally compressed, greenish to stramineous, florets 2 or 3, perfect, occasionally the upper floret is much reduced and sterile; lower rachilla internodes 1–2 mm long, usually not visible, glabrous, smooth; glumes equal to subequal, lanceolate,

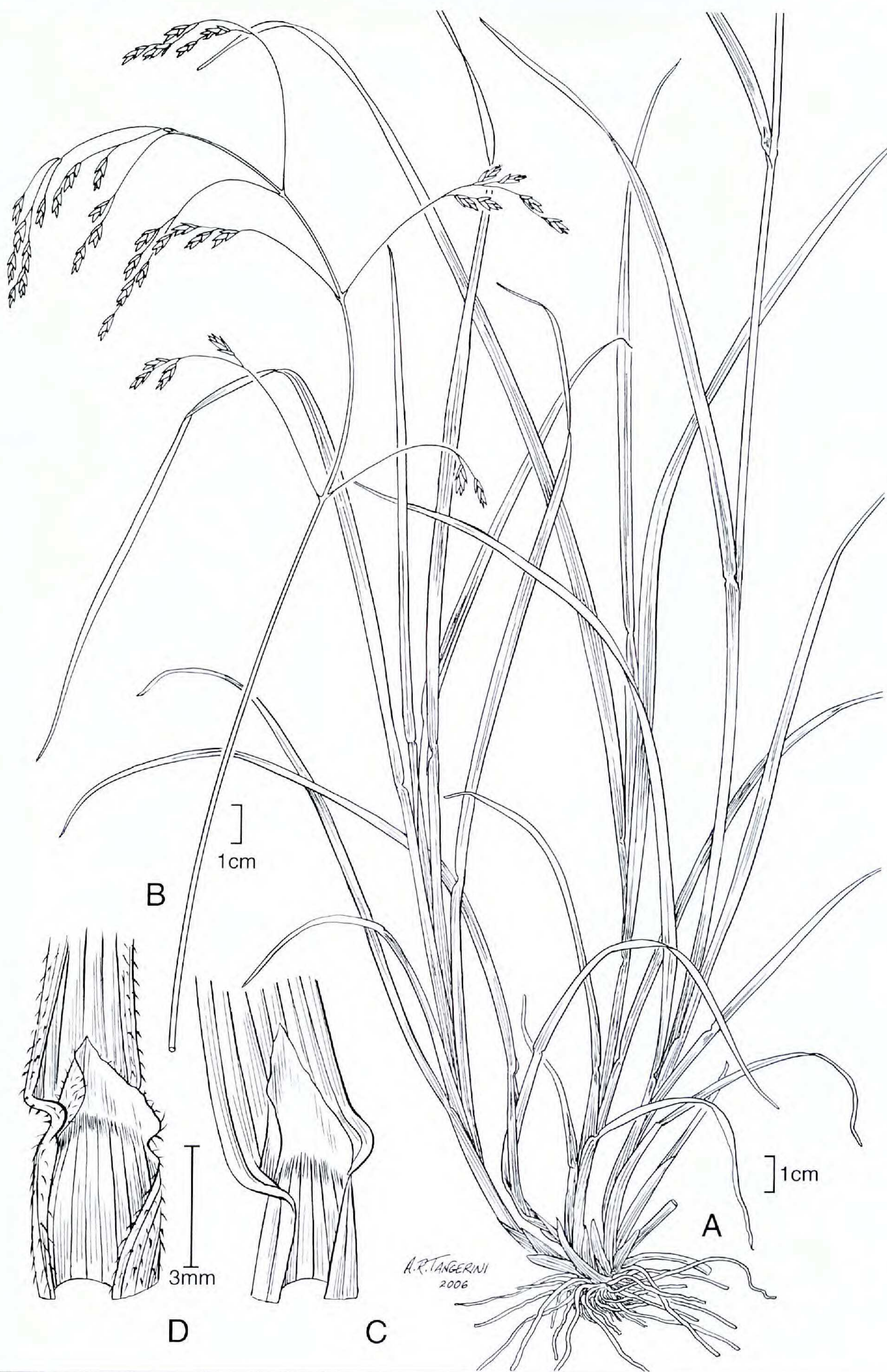


FIG. 1. *Poa matri-occidentalis* subsp. *matri-occidentalis* (Peterson 19145 & Sánchez Alvarado). **A.** Habit. **B.** Inflorescence. **C.** Sheath, ligule, and blade. *Poa matri-occidentalis* subsp. *mohinorensis* (Nesom 6475 & McDonald). **D.** Sheath, ligule, and blade.

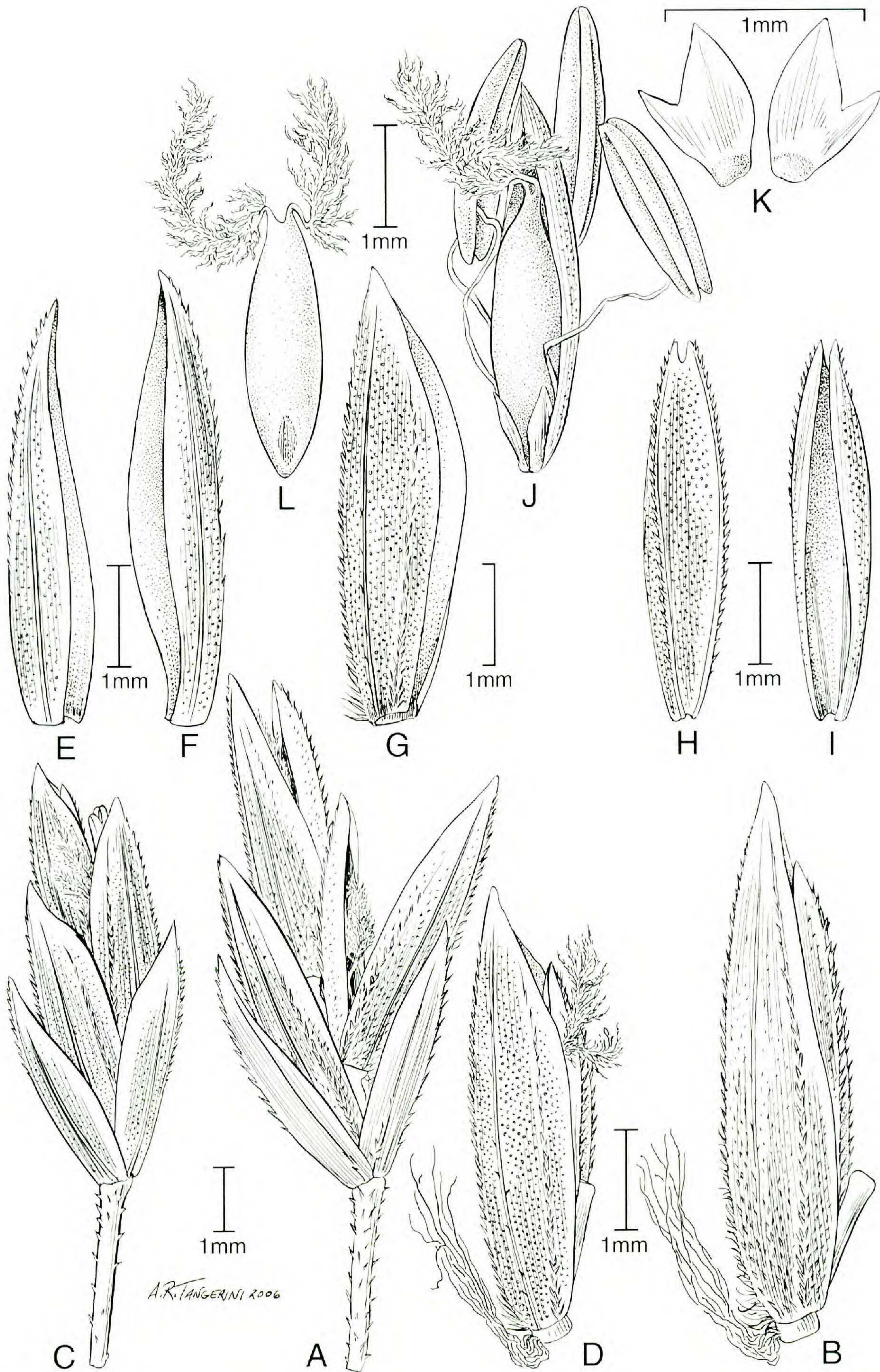


FIG. 2. *Poa matri-occidentalis* subsp. *mohinorensis* (Nesom 6475 & McDonald). **A.** Spikelet. **B.** Floret. *Poa matri-occidentalis* subsp. *matri-occidentalis* (Peterson 19145 & Sánchez Alvarado). **C.** Spikelet. **D.** Floret. **E.** Lower glume. **F.** Upper glume. **G.** Lemma. **H.** Palea, dorsal view. **I.** Palea, ventral view. **J.** Stamens, ovary, and lodicules enclosed in palea. **K.** lodicules. **L.** Young caryopsis.

scabrous along the upper keel, distinctly keeled, 3-nerved, the lateral nerves often only evident near base, scaberulous along the nerves, apex acute to acuminate, often appearing mucronate because the margins are often involute, margins hyaline; lower glumes 3–5 mm long, lanceolate to ovate usually shorter than the upper; upper glumes 3.7–5.6 mm long, ovate to obovate, wider than the lower with more prominent nerves; calluses with cob-webby hairs, the hairs about 1/2 to 1/3 the length of the lemma; lowest lemmas 4.6–6.3 mm long, ovate, distinctly keeled, surfaces between nerves finely muriculate (with minutely pointed, whitish bumps on the short cells) or sometimes densely scabrous, 5-nerved, the lateral nerves moderately prominent, keel and lateral nerves scabrous, keel and marginal nerves glabrous or sometimes puberulent below, margins hyaline, apex obtuse to acute; lowest paleas 4.4–6 mm long, usually a little shorter than the lemmas, strongly laterally compressed with a deep adaxial furrow between the nerves, muriculate, scabrous along the nerves; anthers 2–2.2 mm long, yellow; lodicules 2, membranous; ovary glabrous. Caryopses 2.6–2.9 mm long, fusiform, light brownish.

Phenology.—Flowering August through October.

Comments.—The new species can be distinguished from *Poa kelloggii* by having leaf sheaths that are closed near the base 2/3 to 4/5 their length, entire ligules that are 3.5–6 mm long, nodding panicles, ovate lemmas with obtuse to acute apices, and non-visible rachilla internodes.

***Poa matri-occidentalis* subsp. *matri-occidentalis* (Figs. 1a–c; 2c–l; 3a–c; 4).**

Lower leaf sheaths glabrous and smooth; collars smooth or with a few hooks, glabrous; ligules glabrous and smooth. Lowest lemmas 4.7–5.4 mm long, surfaces between nerves finely muriculate (with minutely pointed, whitish-bumps on the short cells), keel and marginal nerves scabrous, glabrous throughout.

Distribution and habitat.—Known only from a single locality at Cerro Gordo, Durango, between 3130–3200 m where the species was found growing on steep, rocky, and grassy slopes beneath open forests of *Pseudotsuga menziesii* (Mirb.) Franco, *Quercus* sp., *Pinus* spp., with other associates, such as: *Arctostaphylos pungens* Kunth, *Bromus carinatus* Hook. & Arn., *B. richardsonii* Link, *Aegopogon cenchroides* Humb. & Bonpl. ex Willd., *Trisetum viride* (Kunth) Kunth, *Festuca* sp., *Carex* sp., and *Agrostis* sp.

Leaf anatomy.—Cross-sections were done by hand on re-hydrated material then mounted on temporary slides and stained with concentrated safranin. A diagram of a cross-section and abaxial leaf scrape were made with the aid of a camera lucida (Figs. 3a–c, 4).

Cross-section view (Fig. 3a–c).—The lamina are V-shaped with primary, secondary, and tertiary vascular bundles of decreasing size. The primary vascular bundles are well differentiated into xylem with metaxylem, phloem, and a double bundle sheath (mesophyll and parenchyma bundle sheath). The ribs are rounded and furrows are <1/5 as deep as the width of the blade adaxially and abaxially. Abaxial projection of the midrib caused by inflated parenchyma cells and sclerenchyma is conspicuous. In half-the-width of the blade there is a single primary vascular bundle comprising the midvein; 3–4 additional primary vascular bundles; 3–4 secondary vascular bundles placed between consecutive tertiary vascular bundles; 7–8 tertiary vascular bundles placed between each consecutive primary and secondary vascular bundles; and two tertiary vascular bundles at the margin (i-iii-ii-iii-i-iii-ii-iii-i-iii-ii-iii-iii). All vascular bundles are placed in the median layer of the blade and are round in outline. The xylem of the primary vascular

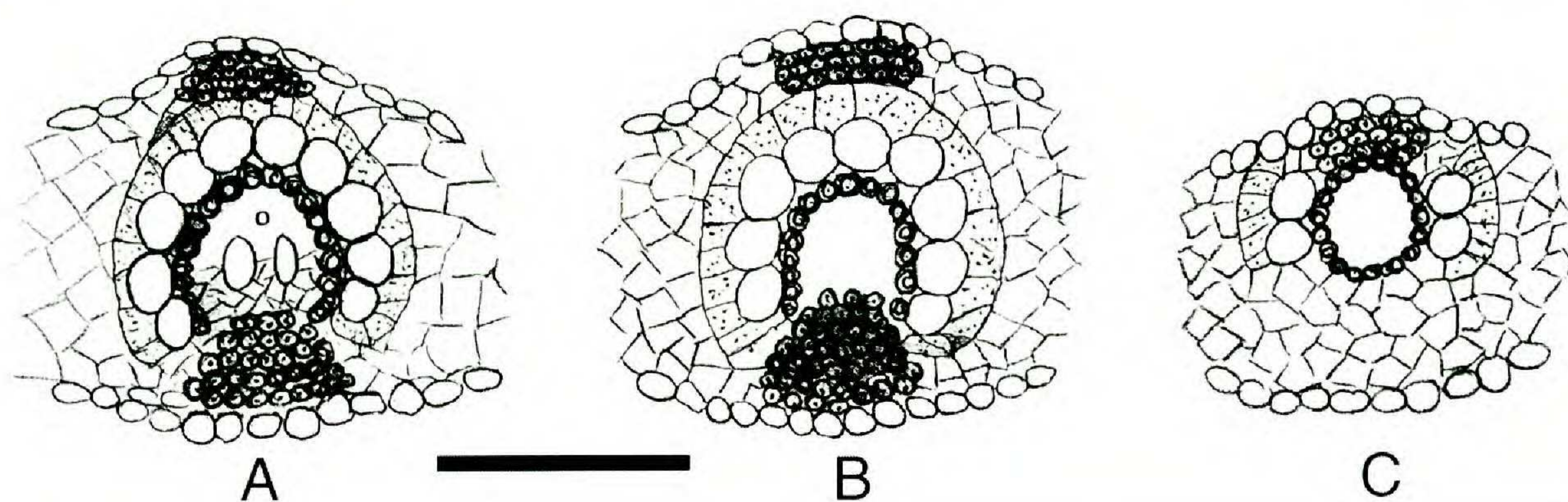


FIG. 3. Cross-section leaf blade anatomy of *Poa matri-occidentalis* subsp. *matri-occidentalis* (Peterson 19145 & Sánchez Alvarado), adaxial surface uppermost in all drawings. A. Primary vascular bundle. B. Secondary vascular bundle. C. Tertiary vascular bundle. Scale bar = 50µm.

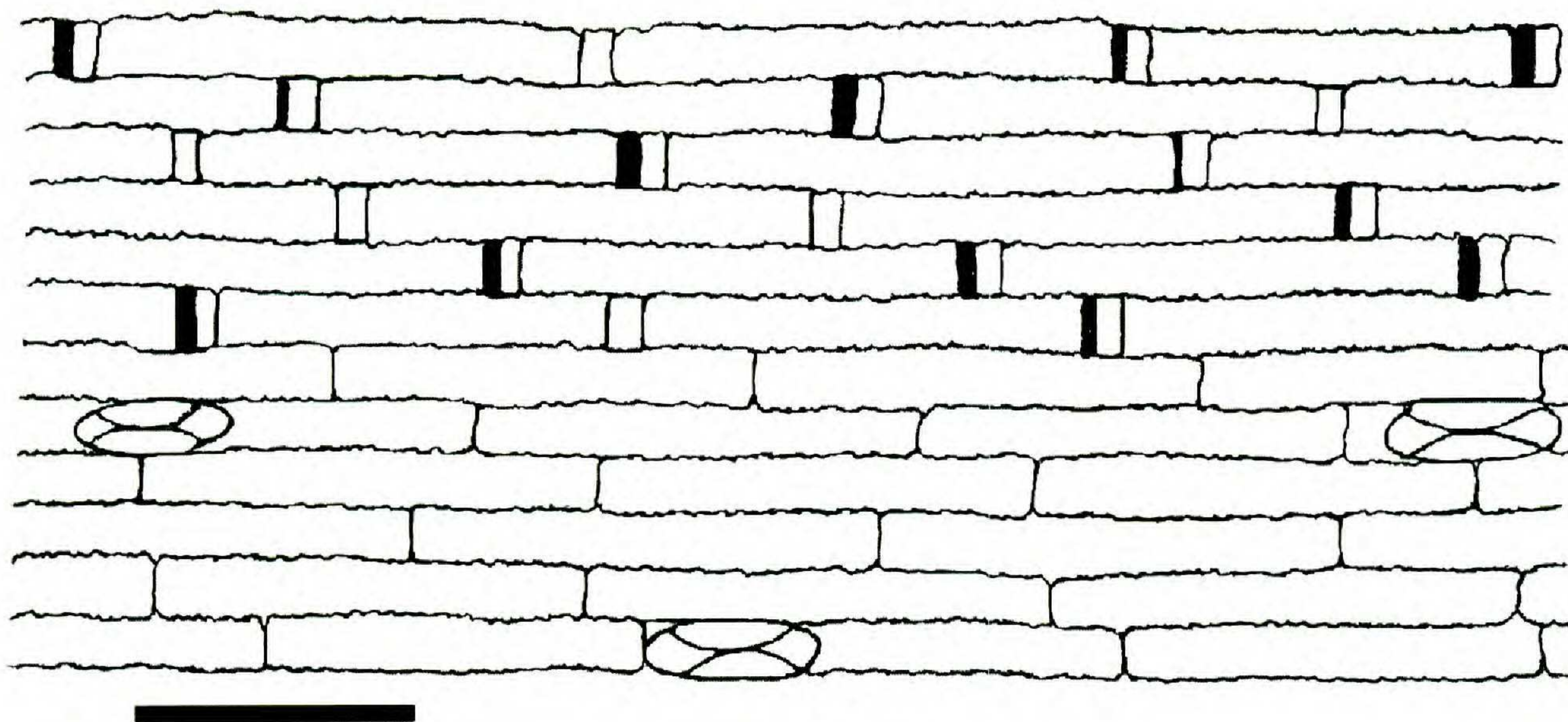


FIG. 4. Abaxial leaf epidermis of *Poa matri-occidentalis* subsp. *matri-occidentalis* (Peterson 19145 & Sánchez Alvarado) showing long cells, silica bodies (dark), cork cells (clear), and three stomata. Scale bar = 50µm.

bundles contains two or occasionally three metaxylem vessels adjacent to the phloem, that are larger than the parenchyma bundle sheath cells, and sometimes one or two protoxylem vessels are located adaxially to the phloem. The mestome, or inner sheath, is always present in primary and secondary vascular bundles surrounding the xylem and phloem. The Mestome is composed of small cells with thick walls and interrupted abaxially by sclerenchyma fibers forming a girder in primary and secondary bundles, except in the central primary vascular bundle where it is continuous surrounding the bundle and the sclerenchyma is separated from the bundle by colorless cells and centered at the very bottom of a conic abaxial base. The parenchyma bundle sheath, or outer layer, contains large, thin-walled cells; 10–12 cells are present on the continuous adaxial half circle of the primary vascular bundle sheath; 6–8 cells are present in the secondary vascular bundles; and the number of cells varies between three and four on each side of the interrupted tertiary vascular bundles. Chlorenchyma cells surround the bundles and are conspicuously continuous between the vascular bundles in a loose arrangement. Five

to eight sclerenchyma fibers are present adaxially in all bundles. Five to eight rows of sclerenchyma fibers form the abaxial girders of the primary and secondary vascular bundles, which widen near the epidermis and narrow toward the vascular bundle. Deep fan-shaped rows of bulliform cell are located adaxially near the central part of the blade between the central primary vascular bundle and two lateral tertiary vascular bundles; these are continuous to adaxial epidermal cell walls.

Epidermis in abaxial view (Fig. 4).—Costal and intercostals zones are clearly distinguishable. Three to six rows of short cells are found in the costal zone, each separated by a row of long cells. Irregularly-shaped silica bodies are alternate and adjacent to short cells of the costal zone. Cork cells are less frequent and the same shape as the silica bodies. Fifteen to seventeen rows of long cells are common in the intercostal zone. Long cells are 8–10 times longer than wide with wavy cell walls. No papillae or hairs are present. Low dome-shaped stomata are infrequent and found in single row. Parallel subsidiary cells are rounded in outline. A few antrorse bristles are present at foliar margin.

Poa matri-occidentalis* subsp. *mohinorensis Soreng & P.M. Peterson, subsp. nov. (Figs. 1d; 2a, b). TYPE: MÉXICO. CHIHUAHUA: Municipio de Guadalupe y Calvo, Sierra Madre Occidental, N side of Cerro Mohinora, ca. 13 mi SW of Guadalupe y Calvo, open pine-fir woods with scattered spruce, nearly vertical, N-facing rock wall, very moist with many bryophytes and rich herbaceous flora (25°57'N–107°03'W), 2950 m, 20 Aug 1988, G. Nesom 6475 & A. McDonald (HOLOTYPE: TEX!; ISOTYPE ARIZ).

A *Poa matri-occidentalis* subsp. *matri-occidentalis* vaginae disatalibus et lemmatae carina puberulens, internerviis scabris, differt.

Lower leaf sheaths retrorsely scabrous to puberulent; collars ciliate; ligules puberulent. Lowest lemmas 4.6–6.3 mm long, surfaces between the nerves densely scabrous, keel and marginal nerves scabrous and puberulent below.

Distribution and habitat.—Known only from Cerro Mohinora, Chihuahua between 2950–3130 m, on moist, rocky cliffs and ledges associated with open forests of *Pinus*, *Abies*, and *Picea*.

Additional specimen examined. **MÉXICO. Chihuahua**: Municipio de Guadalupe y Calvo, Sierra Madre Occidental, on high ledges on summit of Cerro Mohinora (25°57'N–107°03'W), 10,000–10,300 ft, 16–17 Oct 1959, D.S. Correll 23177 & H.S. Gentry (LL).

DISCUSSION

Based on morphological similarity to *Poa kelloggii*, endemic to California, *P. matri-occidentalis* is tentatively placed in *Poa* sect. *Sylvestres* V.L. Marsh ex Soreng. *Poa* sect. *Sylvestres* as treated for the genus in the Flora of North America, includes seven species, all of which are endemic to forests in the U.S.A. and southern Canada (Soreng in press).

[*Poa* sect. *Sylvestres* slightly modified from Soreng in press] “Plants perennial; usually non-rhizomatous and non-stoloniferous, sometimes shortly rhizomatous, usually loosely tufted, infrequently densely tufted. Basal branching mainly pseudointravaginal, or sometimes mainly extravaginal. Culms 20–126 cm, terete or weakly compressed. Sheaths closed (1/20)1/3 to about their full length, terete or weakly keeled, basal sheaths readily deteriorating; ligules 0.1–3(–4) mm long, smooth or sparsely scabrous, truncate to obtuse, entire or lacerate, smooth or ciliolate; blades smooth or scabrous, glabrous, apices narrowly prow-shaped. Panicles 4–36 cm long, erect or lax, pyramidal or lanceoloid, usually sparse, lower rachis internodes usually longer than (2–)3 cm, nodes with 1–10 branches; branches ascending to spreading or eventually reflexed, lax or straight, angled, angles scabrous, spikelets confined to distal 1/5–1/3(–1/2). Spikelets 2.5–8.2 mm long,

laterally compressed; florets (1-)2-5(-6), normal; rachilla internodes smooth, usually glabrous, sometimes hairy, hairs to 0.2 mm long. Glumes distinctly keeled, scabrous on the keel and nerves; calluses terete or slightly laterally compressed, usually dorsally webbed, sometimes glabrous; lemmas 2.1-5 mm long, lanceolate to broadly lanceolate, distinctly keeled, glabrous or hairy, apices with narrow, clear or white margins; palea keels scabrous, glabrous or with hairs over the keels; anthers 3, 0.4-2(-2.6) mm long.”

Based on DNA sequence analyses, *Poa* sect. *Sylvestres* is the earliest diverging section in the genus, if *Arctopoa* (Griseb.) Prob. is excluded, as we now believe it should be (Gillespie et al. in prep.). However, the new species differs in some respects from all or most of the other species in the section. Like *P. kelloggii*, *P. matri-occidentalis* is short rhizomatous and its basal branching is primarily extravaginal. *Poa matri-occidentalis* differs from all the other species in the section by having longer ligules (3.5-6 mm long). If the new species is confirmed to belong to this section (viz. DNA sequence analysis) it would be the first report from outside the U.S.A. and Canada. Our only hesitation to placing the new species in this section is that there is some morphological overlap with *Poa* sect. *Homalopoa* s.l. and with the *P. nervosa* (Steud.) Vasey complex of *Poa* sect. *Madropoa*, and currently, there are no DNA data for the new species. In *Poa* sect. *Madropoa*, through subsp. *mohinorensis*, *P. matri-occidentalis* most closely approaches *P. tracyi* Vasey from New Mexico and Colorado U.S.A. (as noted on the 1989 annotation by J.R. and C.G. Reeder on *Nesom* 6475), and “*P. ruprechtii* Peyr.” (as that name is applied to material from the Sierra Madre Oriental, México). *Poa matri-occidentalis* differs from both these species by having muriculate or short-pubescent on the lemmas and only perfect flowers. The new species differs from “*P. ruprechtii*” by having longer glumes that are also proportionally longer relative to the adjacent lemmas and by fewer florets per spikelet. We suspect the name *P. ruprechtii* Peyr. s. str. may be misapplied in northern México’s Sierra Madre Oriental as material called this by Hitchcock (1913) and Fournier (1886), from the region of the type locality, in the State of México and Distrito Federal, differs in having short anthers, and more indurate and prominently nerved lemmas with relatively longer glumes, but we have yet to locate and examine a type specimen of *P. ruprechtii*. If our suspicion is correct, the Sierra Madre Oriental plants probably represent an additional new species.

A key to all known or reported species from northern México follows. In this key all measurements were taken from the lowest, one or two florets in the best-developed spikelets.

KEY TO THE SPECIES OF POA IN NORTHERN MÉXICO

- 1. Plants annual; palea keels pubescent in part.
 - 2. Callus with cobwebby hairs; panicles contracted _____ **P. bigelovii**
 - 2. Callus glabrous; panicles open.
 - 3. Anthers 0.6-1 mm long _____ **P. annua**
 - 3. Anthers 0.2-0.5 mm long _____ **P. infirma**
- 1. Plants perennial; palea keels scabrous only.
 - 4. Anthers 0.5-1 mm long callus webbed.
 - 5. Lemmas glabrous or very sparsely puberulent on the keel base; spikelets broadly ovate _____ **P. orizabensis**
 - 5. Lemmas short villous on the keel and lateral nerves and sometimes puberulent between the nerves; spikelets broadly lanceolate (of Distrito Federal and State of México) _____ **P. ruprechtii**
 - 4. Anthers 1.2-3 mm long; callus glabrous or pubescent.
 - 6. Plants without rhizomes or lateral tending shoots, densely tufted, vegetative shoots mainly intravaginal.

7. Upper glumes (3–)5–7-nerved; lemmas pubescent on lower half of the keel; longest branches up to 3.5–3.8 cm long; plants 20–42 cm tall _____ **P. mulleri**
7. Upper glumes 3-nerved; lemmas glabrous or very sparsely puberulent on the keel and marginal nerves near the base; longest branches up to 10 cm long; plants mostly (20–) 40–100 cm tall _____ **P. strictiramea**
6. Plants with rhizomes or lateral tending extravaginal shoots, densely to loosely tufted, vegetative shoots intravaginal and extravaginal or mostly extravaginal.
8. Panicles contracted, fairly dense; uppermost leaf blades highly reduced or absent; populations dioecious or pistillate; callus glabrous.
9. Lemmas glabrous _____ **P. fendleriana** ssp. **albescens**
9. Lemmas pubescent on the keel and marginal nerves _____ **P. fendleriana** ssp. **fendleriana**
8. Panicles loosely contracted to wide open; uppermost leaf blades well-developed; plants all perfect flowered, or, if pistillate in part, then panicles open; callus, at least of proximal lemmas, with cobwebby hairs or glabrous.
10. Lemmas glabrous or sparingly puberulent near the base of the keel; upper glumes 3.7–5.6 mm long; ligules obtuse to acute, 3–6 mm long.
11. Sheaths of lower leaves retrorsely scabrous to puberulent; collars ciliate; lemmas densely scabrous between the nerves, keels and marginal nerves nerves puberulent below _____ **P. matri-occidentalis** ssp. **mohinorensis**
11. Sheaths of lower leaves smooth, glabrous, collars smooth or with a few hooks, glabrous; lemmas finely muriculate between the nerves, keel and marginal nerves glabrous below _____ **P. matri-occidentalis** ssp. **matri-occidentalis**
10. Lemmas distinctly pubescent on the keel and marginal nerves; ligules truncate to obtuse, 1–3 mm long.
12. Culms and nodes strongly compressed, keeled _____ **P. compressa**
12. Culms and nodes terete, or culms weakly compressed.
13. Rachilla internodes mostly hidden from view; spikelets mostly 3–6 mm long; lemmas glabrous between the keel and marginal nerves; ligules truncate, entire, usually 1–2 mm long _____ **P. pratensis**
13. Rachilla internodes exposed; spikelets 4.5–8 mm long; lemma surfaces (at least the proximal most ones) with hairs between the keel and marginal nerves near the base; ligules obtuse, irregularly dentate, to 3 mm long (of Sierra Madre Oriental) _____ **"P. ruprechtii"**

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